MEDICAL

INFRARED THERMOMETRY

QUESTIONS AND ANSWERS

tyco Healthcare

Accuracy

Is the Genius* thermometer as accurate as my current thermometer?

Since utilizing the tympanic membrane as the primary source of radiation eliminates most of the variables that can cause an inaccurate temperature from other more traditional sites, you are probably getting a more accurate temperature than you are used to seeing. Because the tympanic membrane shares the blood supply with the hypothalamus, the part of the brain that regulates temperature, it is a good approximation of true, or "core" temperature. Infrared thermometry is "real time," giving you a clearer picture of current temperature status; electronic predictive thermometers "predict" temperatures.

What are equivalences[1] and how are they determined?

Before infrared thermometry, clinical temperatures were measured orally, rectally, or in special cases, with indwelling temperature probes. If one patient's temperature was measured simultaneously with each of these methods, all three temperature readings would be different.

Taken from clinical studies, a computation for the average difference in temperature measurement has been made for each of these sites. The Genius thermometer automates a reading according to a user-selected equivalence, which is based on statistical differences. This provides the user with a frame of reference for interpreting the temperature. Equivalences DO NOT predict temperatures at other sites.

The following equivalences are available on the Genius thermometer:

1. **CAL:** The display will indicate the actual ear temperature without adjustment. This equivalence should be used for calibration only.
2. **ORAL:** Genius thermometers are shipped in oral equivalence. This is the suitable setting for most adult medical-surgical applications. In neonates, the ORAL equivalence is recommended, as it estimates an axillary frame of reference, the current standard for that group.

3. **RECTAL:** The infrared ear temperature is adjusted to display a rectal temperature estimate. Rectal temperature is generally 0.54°C (1°F) higher than oral temperature. This may be appropriate for a paediatric setting where medication protocols have been based on rectal temperatures.

4. **CORE:** The infrared ear temperature is adjusted to a core temperature (i.e. internal body) estimate. Core temperature is generally 0.43°C (0.8°F) higher than oral temperature. This may be used in any situation where core temperature is desired such as in an Intensive Care Unit.

By having these equivalences available, the Genius* thermometer allows for the fact that body temperature varies as much as ±1°C in different areas of the body. Health care providers have medication protocols that base treatment on temperature relative to site, not method of thermometry.

[1]Equivalences are sometimes casually referred to as "modes."

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Does cerumen affect the accuracy of infrared ear temperatures?

Ear wax is translucent to infrared energy so moderate amounts do not affect measurement accuracy. A cerumen impaction, however, may trap dirt and debris which could lower temperatures by several tenths of a °C.

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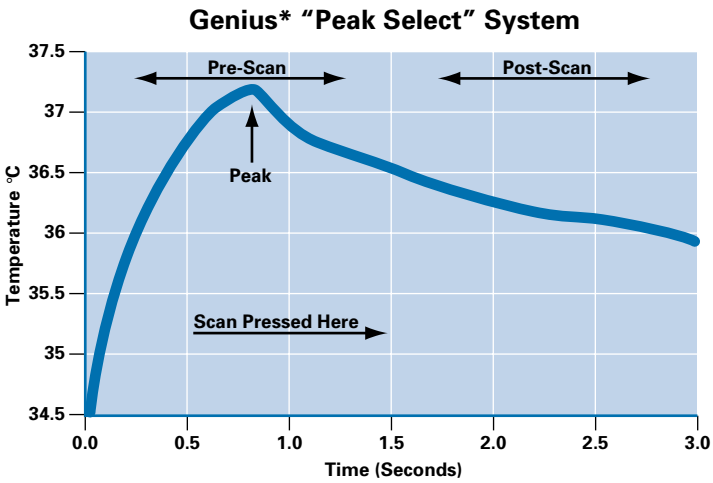
What is the "Peak Select" system?

"Peak Select" assures that the highest temperature detected is displayed. As soon as a new probe cover is in place, the Genius thermometer begins measuring and storing temperature signals. The temperature should be taken as soon as possible after the probe cover is installed. When the SCAN button is pressed, the last 16 readings are stored along with an additional 16 readings. The 32 data points are then sorted, and the highest temperature is displayed on the screen. This process compensates for the "draw-down" effect (see "draw-down" question, pg. 5).



How is the thermometer calibrated?

Genius* thermometers are initially calibrated at our manufacturing facility, using precision NIST traceable temperature reference chambers. Each contains four temperature controlled black-body references, each set to a different target temperature. Genius thermometers are checked against each of the four test temperatures under a variety of ambient temperature environments. Over 200 data points are used to generate the calibration surface for the thermometer. Thermometer calibration should be verified every six months using a Genius calibrator. This can be done by a medical technician trained by the company or by returning the thermometer to the Service Centre.

For further information concerning calibration contact the Technical Helpline. Tel: 028 27 661725 or Fax: 028 27 664799.

How do extremes of ambient temperature affect infrared ear temperatures?

This answer has two parts: the effects on the Genius thermometer itself, and the effect on the person being monitored.

Minor changes in ambient temperature can affect a person's temperature. Even a brief 20-minute exposure to extreme weather (hot or cold) can change the temperature gradient down the ear canal and alter the true reading. It is advised to wait 10 to 20 minutes for the ear temperature to re-equilibrate to normal room temperature.

Again, minor changes of ambient temperature (within the Genius* thermometer's effective range of 15.6°C-35.0°C) have no noticeable effect on performance. However, when the Genius thermometer is moved to a setting with marked temperature difference (such as from cold outdoors to a heated building), allow 45 minutes for the thermometer to equilibrate to the new temperature before using.

Technique

Q A How important is technique?

User technique is the single most important factor to ensure accuracy of temperature readings. The ear must be sealed to become a "black body" and give a good reading. The probe must be aimed at the warmest part of the ear, the tympanic membrane. The procedure for adults and children is outlined in the "specific applications" section of this brochure. Additionally, reading the Operation Manual thoroughly and reviewing the training video and literature before using the Genius thermometer will reinforce good technique.

For more information regarding technique and training contact Tel: 01329 224226 or Fax: 01329 224390.

Q A How do I know I have a good seal when I take a temperature?

For adults, place probe gently in the ear canal as far as it will go, and seat the probe in the ear opening, then rotate the probe handle along the jawline toward the mouth as if holding a telephone. Press SCAN immediately. With some patients you may need to gently retract the tragus to open the canal for the tip to fit snugly. This gives the best position toward the tympanic membrane.

For children, first look at the direction of the ear canal; then insert the probe tip, or place the probe tip directly over the opening of the ear canal, sealing the external auditory meatus (opening). Aim the probe tip down the ear canal and press SCAN. If necessary, open the canal even more by retracting the skin in front of the tragus.[1]

In infants as in all other ages, it is important that the patient does not draw away from the thermometer and that it not be removed before the triple beep is heard and the screen flashes DONE. Removing the Genius* thermometer prematurely will result in too low a reading.

[1]The protruding cartilage tab on the front of the ear opening.

Q A

What is "draw-down"?

When objects of two different temperatures, such as the ear canal and the Genius* probe tip, come in contact, the cooler object will draw heat from the warmer object and "draw down" its temperature. That would result in an artificially low temperature. However, the "Peak Select" system takes temperature readings before and after the SCAN button is pushed, so that the highest temperature is captured and reported, even after cooling starts. If taking two temperatures in the same ear, allow 2-3 minutes between measurements to allow for draw-down recovery.

Q A

Why do I get different readings in the left and right ear?

If the temperature does vary, the most likely reasons could be:

- Poor seal due to angle of approach; will diminish as technique improves,
- Anatomical differences,
- Positioning – lying against a surface causes heat to build up in the "down" ear rather than dissipate.

Controlled research studies where technique is standardised have shown no significant difference between ears in the same person. If a large difference is noted consistently in a patient, it should be noted in the chart and the ear with the higher temperature used.

Maintenance

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How durable is the GENIUS* thermometer?

The GENIUS thermometer has a 3-year warranty and undergoes extensive durability testing. However, it is a precision optical instrument and should be treated with care. The GENIUS thermometer should never be dropped or handled roughly. Always "click" the thermometer back into the base unit when the temperature reading is completed.

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How do I clean the probe tip?

The probe lens should be cleaned by wiping with a dry lens wipe, tissue or lint-free swab. If the lens is still dirty, it may be cleaned with a swab moistened with a small amount of isopropyl alcohol. Point the probe down to prevent any alcohol from seeping past the tip. Thoroughly buff lens with a dry tissue, and allow the probe to readjust from the cooling effects of the alcohol for 45 minutes before it is used. Cleaning of the other parts of the thermometer is fully explained in the Operation Manual and summarised on training wallcharts.

For more information regarding the care and cleaning of the GENIUS thermometer contact Tel: 01329 224226 or Fax: 01329 224390.

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What about pilferage?

To prevent units from "walking off," many alternatives are suggested:

- Anti-theft devices may be fitted,
- Wall mounts or mobile stands may be used,
- Units may be locked up when not in use.

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Does the GENIUS thermometer have to be returned to its base frequently to recharge or ensure accuracy?

The base unit for the GENIUS thermometer is there to protect it from being damaged

while not in use and to hold the unused probe covers. It has no role in maintaining calibration or battery charge. The battery is in the thermometer itself. When the thermometer goes unused for 30 seconds after installing a probe cover, it enters a power-saving SLEEP mode and must be reactivated by pressing RELEASE and installing a new probe cover. Batteries are effective for approximately 5000 temperatures.

How often does my PC calibrator need to be calibrated?

Tyco recommends that the GENIUS PC calibrator be checked for proper calibration every 12 months.

For further information contact the Technical Helpline.
Tel: Tel: 028 27 661725 or Fax: 028 27 664799.

Specific Applications

Will the device work with infants?

The GENIUS thermometer is ideally suited to work with infants when proper technique is used. It is most important to seal off the external ear canal without putting undue pressure on the canal cartilage, which is easily compressible. The temperature in that case would be falsely low due to primarily reading the cooler auditory canal temperature rather than the warmer tympanic membrane.

To use the GENIUS thermometer with infants, retract the skin in front of the tragus and place the probe tip over the external auditory meatus. Aim the probe tip in the direction of the ear canal, making sure there is a good seal over the external auditory meatus. Once the probe is in place, release the skin which will then close on the probe tip helping to form a seal. Press SCAN button.

Older infants who have traditionally had their temperatures taken rectally should have the GENIUS thermometer set in RECTAL mode. Always use ORAL equivalence with neonates. This provides the axillary frame of reference, the standard in this population.

Isn't the probe tip too large for infants?

The probe tip is designed to prevent dangerous penetration of the infant ear canal. Simply sealing the outside of the canal and angling the probe in the direction of the canal is sufficient for an accurate reading, provided the canal is kept open.

Can I use the GENIUS thermometer in patients with pressure equalization (PE) tubes?

Tubes do not appear to affect infrared results directly, but for patient comfort and compliance, wait at least one week post-op.

Can the GENIUS thermometer be used in the neonate population?

Yes, the GENIUS thermometer may be used on normal full-term neonates in open cots. When measuring the temperature of neonates in open cots, the ORAL setting should be used which will provide an infrared ear temperature normally seen at the axillary site.

Due to factors such as prematurity, birth weight, illness etc., some neonates may require warming in special environments (incubators, isolettes, radiant warmers) to maintain proper body temperature. Neonates in these artificially warmed environments generally display a different body temperature gradient than neonates in open cots (Mayfield et al., 1984). Although these special environments affect temperature readings at the ear because of radiant and convective warming of the canal (Mayfield et al., 1984) special attention to the position of the neonate while using the GENIUS thermometer may reduce the degree of error. Whether a neonate is lying prone, supine or on the side in such an environment, one ear must be "up," that is, further from the mattress, and the other "down," that is closer to the mattress. Using the GENIUS thermometer in the "down" ear in incubators and radiant warmers may reduce the effect of an artificially warmed ear canal. Keep in mind, however, that clinical studies suggest that infrared ear measurements may register higher readings in incubated or radiant-warmed neonates. Clinical investigators attempting to define acceptable degrees of variability reach no consensus (Keeling, 1992; Weiss, Poeltler & Gocka, 1993).

As always, the consistent use of one site and proper technique when measuring temperatures in neonates are highly recommended (Keeling, 1992).

Q Are there patients who should not have ear temperatures taken?

A The GENIUS thermometer is not recommended for:

- Children with myringotomy tubes less than one week post-op,
- Any patient with moisture (e.g. blood, spinal fluid, tears, saliva, vernix, or mist from a mist tent) in the ear,
- Significant ear pathology or eardrum scarring,
- Any obstruction of the ear canal,
- Stroke patients on the affected side,
- Head injury patients when contraindicated.

Q Does the room light have to be on to take a temperature?

A No, sleeping patients may rest **provided you can see well enough for correct placement**. Infrared senses heat in the absence of visible light. Because the temperature reading display stays on until the next one is taken, it can be measured inside the room and read outside in brighter light.

Keeling, E.B. (1992). Thermoregulation and axillary temperature measurements in neonates: A review of the literature. Maternal–Child Nursing Journal, 20, 124-140.
Mayfield, S.R., Nakamura, K.T., Bhatia, J., Rios, G.R. & Bell, E.F. (1984). Tympanic membrane temperature of term and preterm neonates. Early Human Development, 9, 241-247.
Weiss, M.A., Poeltler, D. & Gocka, I. (1993). Infrared tympanic thermometry for neonatal temperature assessment. JOGNN, 23, 798-804.

FirstTemp* Genius*

For more information on GENIUS thermometer features, calibration, cleaning, or procedures, please refer to the Operation Manual that accompanies each GENIUS thermometer. Further questions regarding the GENIUS thermometer may be directed to Customer Care on
Tel: 01329-224226.

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